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ANCIENT ASTRONOMY.

Recherches sur l'histoire de l'Astronomie Ancienne. Par Paul Tannery. (Paris : Gauthier-Villars et Fils, 1893.)

THE author's previous work, "Pour l'Histoire de la Science hellène," in which early Greek scientific ideas are treated of from the time of Thales to that of Empedocles, and which first appeared in fragments in the pages of the *Revue Philosophique*, leads the reader to open the present with high expectations, which its perusal will assuredly not disappoint. It in no degree trenches upon the ground occupied by the former; but its main object is to furnish an analysis of the Almagest, more accurate and complete than those given by previous writers, and also to discuss the views of those who may fairly be called the precursors of Ptolemy, and especially of Hipparchus. On this latter point M. Tannery's researches have led him to conclusions somewhat different from those which have been generally entertained. The part played by Hipparchus in the progress of astronomy he considers to have been singularly exaggerated, and the ground to have been prepared rather by the earlier writers of the Alexandrian school, particularly by Apollonius of Perga, in the invention of geometrical and trigonometrical methods, and the first systematic combination of recent with earlier Chaldean observations. To illustrate clearly his meaning, he affirms that, without these previous works, Hipparchus would have been unable to accomplish the greater part of that which has made his name immortal; whereas without that of Hipparchus, Ptolemy would have been able in great measure to have composed his Almagest; it would have been undoubtedly much more imperfect and less accurate in many numerical details, but "l'ensemble ne présenterait pas un caractère très notablement différent."

The work begins with an etymological discussion (certainly conducted on historical principles) of the origin of the words (*i.e.* of their Greek equivalents) "astronomy" and "astrology." The former is the older of the two, and is found in Plato and in Aristophanes; the substitution of "astrology" was made by Aristotle. Hipparchus preferred the term mathematician to astronomer or astrologer; and following in his wake, Ptolemy called his great work (for which we usually use the Arabic designation "Almagest") the mathematical composition. It may be interesting to remember that though in modern times the expressions astronomy and astrology returned into use (at first with the same meaning, but the latter became degraded by exclusive application to absurd and superstitious attempts, in the manner of the Chaldeans and Egyptians, to predict future events by supposed planetary influences), yet Flamsteed's favourite way of designating himself was as M.R., for "mathematicus regius." M. Tannery thinks that the term *ἀστρονόμος* preceded that of *ἀστρονομία*, and that it strictly signified one who distributed the stars into groups, or, as we call them, constellations. With regard to the well-known passage in Homer, speaking of the Bear that alone has no part in the baths of the ocean, he takes the poet to include under that name all the stars within the circle of perpetual apparition. The knowledge of the distribution of the stars in the visible firmament was obviously of use in navigation; the extension of this astronomy to reasoning on their motions, for which the expression astrology was afterwards logically preferred by Aristotle, was, we are told by Xenophon, discouraged by Socrates; but the language of the historian rather points to the works of Eudoxus of Cnidus, which appeared subsequently to the time of Socrates.

M. Tannery takes occasion to allude to the famous story or legend of the number of the year in the Metonic Cycle taking its name from its being graven in golden letters on a public square in Athens; whereas Boeckh has proved that the cycle in question was not brought into use there until the reform of Calippus, a century after the time of Meton, and Aristophanes in more than one passage ridicules the disorders of the calendar in his own time.

In his second chapter, M. Tannery treats of the progress made in the science which acquired the name of astrology (but for which modern science prefers the more ancient term astronomy, to avoid confusion with what Kepler called its hair-brained sister, though we refuse to recognise any relationship, and it was felt to be too much trouble always to call the other judicial astrology) during what may be considered the Athenian period, for thither came Eudoxus, who founded the school of Cyzicus and introduced the use of the instrument called the *ἀράχνη*, identical in principle with the astrolabe, the invention of which was long falsely attributed to the Arabs; and there also Calippus conferred with Aristotle. But Alexandria was destined to take the place of Athens as the principal seat of Greek learning. It was, however, to the second period of its prosperity, under the Roman domination, that the astronomical glory of Alexandria culminated in the hands of Claudius Ptolemy, whose work may be said to comprise all that was known of astronomy until the era of Copernicus and Tycho, soon to be followed by that of Kepler and Galileo. Meanwhile one of the islands on the coast of Asia Minor, on which, according to the Greek proverb, the sun always shone, so that it may be presumed that the stars also frequently did at night, had been the scene of the scientific labours of Hipparchus, probably the best known amongst the ancient astronomers. Mr. Chambers calls him "the Newton of Greece," but it is evident that M. Tannery does not share that view at any rate. The illustrious Bithynian is usually considered, he says, "comme un génie absolument hors de pair"; but without desiring in any way to depreciate his very important contributions to science, he adds, "L'importance de son rôle est en tout cas assez grande pour que ce ne soit pas lui faire injure que d'essayer de le ramener à des proportions un peu plus humaines. Il a possédé, sans contredit, les qualités essentielles à un astronome; habile et patient observateur, calculateur émérite, il fut également doué de la sagacité qui conduit aux découvertes capitales et de la puissance de déduction qui permet d'enchaîner les vérités nouvellement acquises dans un système solidement construit. Eut-il, au même degré, le génie de l'invention mathématique? C'est ce qui semble pouvoir être mis en doute."

The author proceeds to show that in many of the

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advances usually attributed to Hipparchus, especially those in which mathematical acumen was requisite, he had been preceded by others, though undoubtedly his store of observations was of great value to his successors, and in practical methods he made many and important inventions. "Trigonometry," we read in the article on Ptolemy in the Encyclopædia Britannica, "was created by Hipparchus for the use of astronomers." M. Tannery gives reasons for believing that his qualifications were not of a kind to enable him to make discoveries of this nature, whilst as for the systematic development of the hypothesis of epicycles and eccentrics to represent the celestial movements (which, since the time of Kepler, "n'est plus que l'objet d'un dédain qu'à vrai dire, elle ne mérite guère en elle-même"), the testimony of antiquity attributes this to the great geometer, Apollonius of Perga. Even in the systematic utilisation by Hipparchus of the ancient Chaldean observations of eclipses, he had probably to a great extent been anticipated by Conon of Samos, best known as the friend of Archimedes, and for his ingenious flattery of the Egyptian queen by raising her hair to the heavens as the constellation Coma Berenices. Seneca, it is true, speaks of Conon's use of Egyptian observations; but this was in all probability an error for Chaldean, brought about by the astronomer's residence in Egypt. It would seem, in fact, that Hipparchus should rather be compared to Flamsteed than Newton amongst the moderns. M. Tannery goes on to dwell upon the mathematical importance of the work of Apollonius, who was probably the same as the astronomer of that name who also lived under Ptolemy Philopator, and was called Epsilon on account of his researches on the theory of the moon; the old ordinary form of that letter resembling a crescent.

Geminus and Cleomedes (whose native places are unknown), Theon of Smyrna, the elder Pliny, are passed in review; but the principal part of the work before us respects, as before said, the great composition of Ptolemy, of which a very complete and interesting account is given. The ancient astronomer who, unknown to Copernicus (as it appears only from a work of Archimedes inaccessible to him), had anticipated him in the theory of the earth's motion, was Aristarchus of Samos. But, however worthy of admiration this may be, "on ne doit nullement exagérer le tort que subit la science astronomique par le fait qu'Hipparque et Ptolémée ont maintenu le système géocentrique. Au point de vue mécanique et physique, la conception héliocentrique réalisait un immense progrès; au point de vue géometrique, que la science des anciens n'a pas dépassé pour les astres, cette conception ne présentait aucun avantage réel." The position and work of Copernicus is so often little understood, that it may be well here to quote further M. Tannery's language:—

> "Le véritable titre de gloire de Copernic est peut-être moins d'avoir réprouvé le système d'Aristarque que d'avoir en méme temps, mais à la suite d'un travail considérable et tout-à-fait indépendant de ce système, simplifié extrêmement les hypothèses relatives aux épicycles et excentriques, tout en conservant les mêmes principes géométriques que les anciens pour l'explication des mouvements des planètes."

The space at our disposal renders it quite impossible to do more than offer some indications of the contents of a work of which we may well say with Osiander of that of Copernicus, "eme, lege, fruere." But we may be permitted to express our concurrence with its closing remark:—"En tout cas, on ne pourra se refuser à admettre cette vérité que *la science ne se développe que lorsqu'elle est cultivée pour elle-même;* voilà sans doute la plus solide conclusion que l'on puisse tirer de son histoire."

There are several interesting appendixes, particularly those on the trigonometry of the ancients, on the great year of Josephus, on the conjectural opinions of the ancients concerning the distances of the planets from the earth, and one (by M. Carra de Vaux) on the celestial spheres of the Persian astronomer Nasir-Eddin Attûsi (born at Tûs in Khorasan, A.D. 1200), with a translation of part of his work. But there is not, what there certainly should be, a general index to the whole. W. T. L.

SCOTTISH LAND-NAMES.

Scottish Land-names. By Sir Herbert Maxwell, Bart., M.P. (Edinburgh and London: W. Blackwood and Sons, 1894.)

THIS book is practically a collection of a course of lectures called the "Rhind Lectures in Archæology," published "just as they were delivered." Sir Herbert Maxwell has done well to print them, by way of furnishing material for future workers, amongst which we may hope that he may himself make one.

The book furnishes a large number of notes and suggestions; and good work might be done by some philological scholar, who would go over the suggested etymologies, and verify them one by one. It is tolerably certain that some of them will not stand any very rigid test; whilst others will, no doubt, be found to be quite correct.

The author clearly recognises the great principle upon which all such investigations must be conducted. We must in every case try to find out the earliest written form in some charter or deed; and it will then often be found that such early form wholly contradicts the suggestion which the modern name presents.

"From a charter of the same king (William the Lion) it is evident that Granton, near Edinburgh, is not, as it appears, Grant's-town, like Grantown-on-Spey; for it is written *grendun*, the Anglo-Saxon *grēne dūn*—green hill." Similarly, we may remark, we find in England such names as Grendon and Grindon.

After laying down this all-important principle, it is not a little surprising to find, at the end of the work, an index of place-names, with etymologies, in which not a hint is given of the authority upon which each explanation rests. Thus "the Braid Hills" is explained from the Gaelic *braghad* (braad), the breast; and, of course, if there is documentary evidence for it, there is no more to be said. But if not, it is by no means clear why *braid* may not be the ordinary Lowland-Scotch word for "broad." In every such case, we have a right to expect that the evidence should in some way be given; precisely as, in Bardsley's book on Surnames, the whole value of the work really resides in the copious lists of references which are given at the end of it.

We have noted a considerable number of other points on which we desire further information. The remarks

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